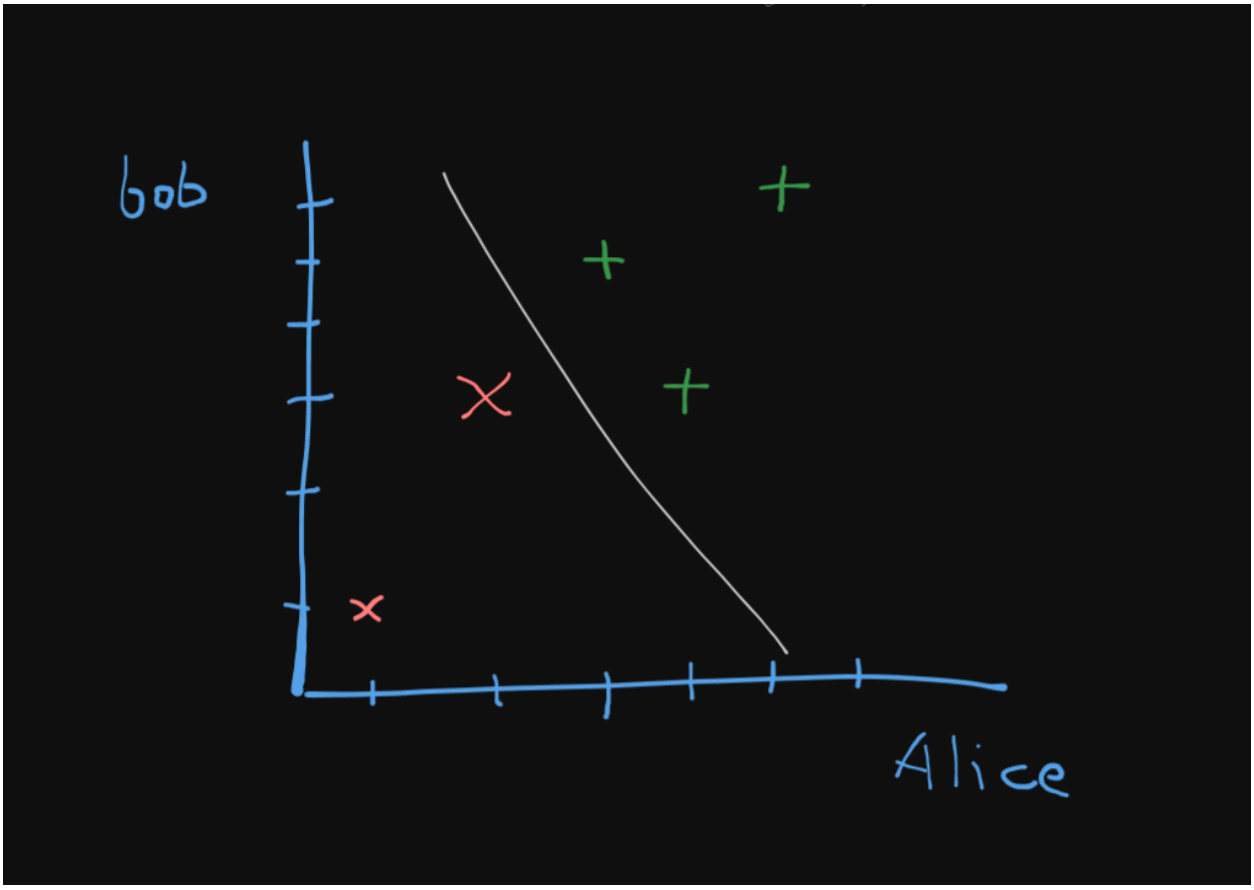
Week 5

Part 1:



Part B:

Step	Weights	Score	Correct Prediction?
1	(1,0,0)	1*(-1) + 0*1 + 0*1 = -1	yes
2	(1,0,0)	1*(-1) + 0*4 + 0*3 = -1	no
3	(-1,8,6)	-1*(-1) + 8*3 + 6*5=55 (1)	yes
4	(-1,8,6)	-1*(-1) + 8*5 + 6*6 =77 (1)	yes
5	(-1,8,6)	-1*(-1) + 8*2 + 6*3 = 35 (1)	no

using the formula for updating weights, the learning rate is 1

$$w_i \leftarrow w_i + \eta(y - \hat{y})x_i$$

w0 = -1 + 1((-1) - 1)(-1) = 1

w1 = 8 + 1((-1) - 1)(2) = 4

w2 = 6 + 1((-1) - 1)(3) = 0

Final updated weights

1 4 0

part 3

$$1(-1) + 4x_1 + 0x_2 = 0$$

$$0x_2 = -1 + 4x_1$$

$$x_2 = \frac{4x_1}{0} + \frac{-1}{0}$$

The weights have not been learned as we get a division by 0

part 4

a perceptron is a linear classifier, meaning it can only separate data with a single straight line (or hyperplane in higher dimensions). If the data is not linearly separable, a perceptron will fail.

scenario 1:

Rule: if the total score (x1 + x2) is more than 8, then the movie is profitable; otherwise it is not

mathematically the decision boundary is given by:

$$x_1 + x_2 = 8$$

This is a linear equation, which means we can define a perceptron with weights w1 = 1, w2 = 1 and w0 = -8

Conclusion: yes a perceptron can perfectly classify this rule since it creates a straight-line boundary

Scenario 2:

the movie is profitable if and only if each reviewer gives either a score of 3 or 4

the profitable points will be above and under the unprofitable datapoints. Meaning that there isn't a straight line that can clearly separate profitable from non-profitable movies.

A perceptron cannot perfectly classify this rule since it is not linearly seperable.

scenario 3:

the movie is profitable irf and only if both reviewers agree

This means the decision boundary is

$$x_1 = x_2$$

This is a linear equation

a perceptron with weights w1 = 1, w2 = -1 and w0 = 0 would perfectly classify this

a perceptron can perfectly classify this rule because the data is linearly separable by the diagonal x1 = x2